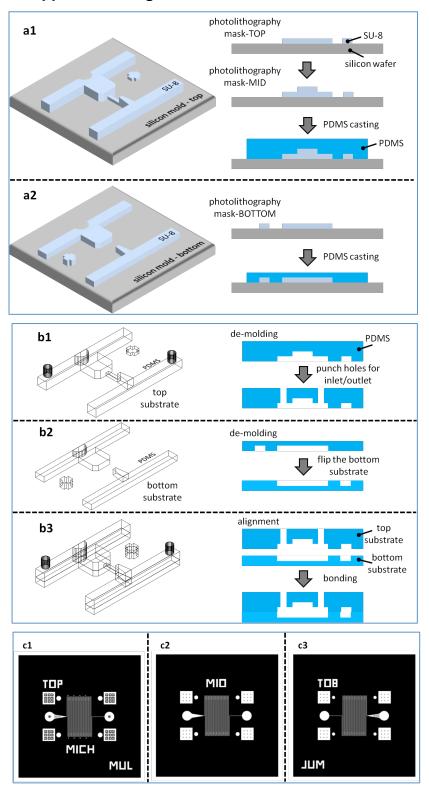
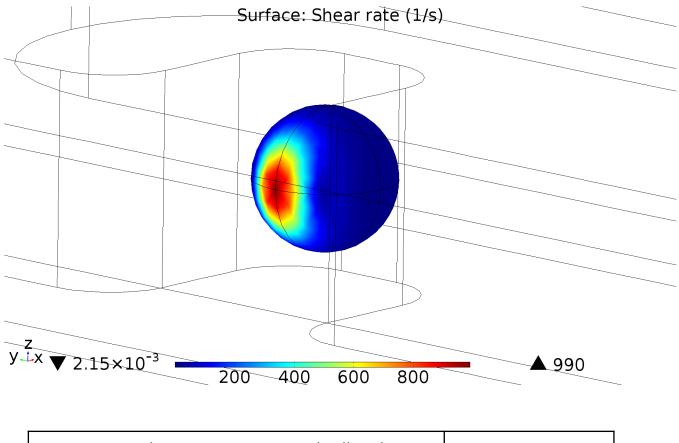
## **Supplemental Figure 1**



**Figure S1**. Fabrication process flow. (a) Fabrication of the SU-8 mold on silicon wafers, (b) PDMS casting, alignment, and bonding for the formation of the microfluidic device. (c) Transparent mask layouts of the  $\mu$ FPA device

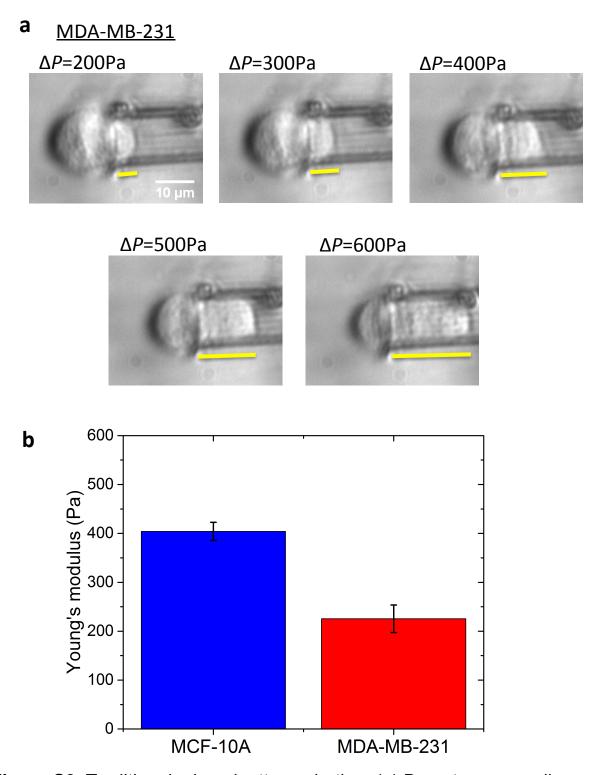
## **Supplemental Figure 2**



average shear stress on trapped cell under maximum flow rate in our μFPA device	0.072 dyn cm <sup>-2</sup>
shear stress required to activate mechanically activated ion channel, PIEZO1, ref [31], [32]	20-40 dyn cm <sup>-2</sup>

**Figure S2**. Shear stress exerted on the cells under aspiration with maximum operation flow rate (0.75  $\mu$ l/min) by numerical simulations.

## **Supplemental Figure 3**



**Figure S3**. Traditional micropipette aspiration. (a) Breast cancer cell (MDA-MB-231) under aspiration, pressure increment for 100Pa for every 10s interval, yellow line indicates the protrusion length (b) Young's modulus of breast healthy (MCF-10A) versus cancer (MDA-MB-231) cell. (MCF-10A:  $404.1 \pm 18.4$  Pa, n = 10 and MDA-MB-231:  $225.5 \pm 28.0$  Pa, n = 14. Error bars represent standard error of the mean